STEERING CONTROL DEVICE

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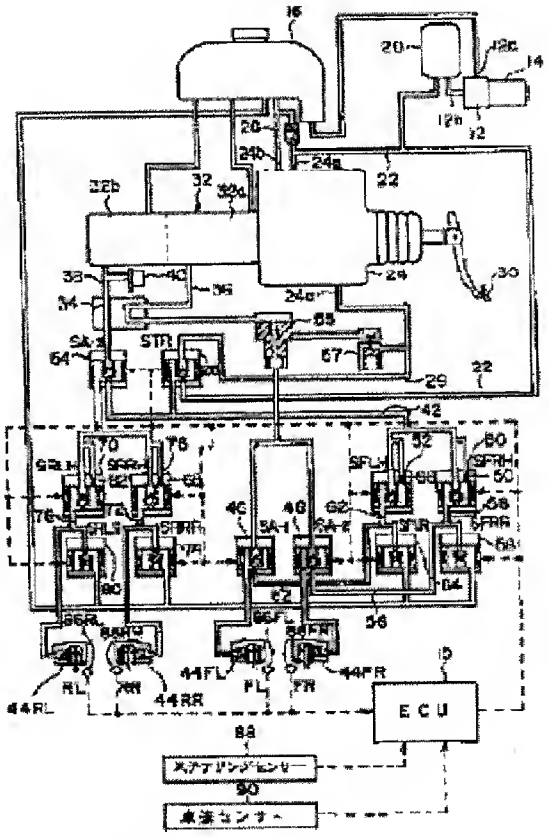
Abstract of **JP11049019**

PROBLEM TO BE SOLVED: To attain improvement of small sharp turn capability by a simple constitution, relating to a steering control device attaining facilitation of operation by selectively applying brake force relating to each wheel. SOLUTION: A steering control device is provided with a steering sensor 88 detecting a steering direction of a steering wheel, brake device (wheel cylinder 44FL, 44FR, 44RL, 44RR) constituted so as to be able to perform brake action independently relating to each wheel, and a brake force control means, based on a vehicle advancing direction (forward or reverse) detected by a car speed sensor 90 and a steering direction detected by the steering sensor 88, generating brake force in a front side turn internal wheel relating to the advancing direction.



* NOTICES *

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MEANS

[Means for Solving the Problem] Thing ****** characterized by providing the means expressed below in this invention in order to solve the above-mentioned technical problem. In the steering control unit concerning invention according to claim 1 A steering angle detection means to detect the steering direction of a steering wheel, and the braking means constituted so that braking actuation could be performed independently to each wheel, An operational status detection means to detect the operational status of a car, and the car travelling direction detected by said operational status detection means, Based on the steering direction detected by said steering angle detection means, before receiving a travelling direction, it is characterized by establishing the damping force control means which makes a side revolution inner ring of spiral wound gasket generate damping force.
[0007] Moreover, in invention according to claim 2, it sets to said steering control unit according to claim 1. A damping force value decision means to determine the damping force value which said damping force control means is made to generate for each wheel based on the velocity ratio (V2/V1) which is a ratio of the rate (V1) of a revolution outer ring of spiral wound gasket and the rate (V2) of a revolution inner ring of spiral wound gasket which are found by said operational status detection means, It is characterized by establishing an optimal velocity ratio operation means to ask for the optimal velocity ratio for which it was most suitable in the current steering condition, based on whenever [car-body-speed / which is detected by said operational status detection means], and said steering angle.
[0008] The above-mentioned means acts as follows. According to invention according to claim 1, a steering angle detection means detects the steering direction of a steering wheel, and transmits this information to a damping force control means. Moreover, an operational status detection means detects the operational status of a car, and transmits the travelling direction **** signal of the car which is one of the operational status to a damping force control means. Moreover, the braking means is considered as the configuration so that braking actuation can be performed independently to each wheel.
[0009] And a damping force control means makes a side revolution inner ring of spiral wound gasket generate damping force based on the car travelling direction detected by said operational status detection means, and the steering direction detected by said steering angle detection means, before receiving a travelling direction. for example, when a travelling direction is the front and the steering direction is the right, a damping force control means makes a before side right wheel generate damping force -- it obtains and a braking means is controlled. Thus, before receiving a travelling direction, by making a side revolution inner ring of spiral wound gasket generate damping force, the TR of the outermost part of the car body at the time of revolution can be made small, and, therefore, small turn nature can be raised.
[0010] Moreover, according to invention according to claim 2, the damping force value which each wheel is made to generate is determined based on the velocity ratio (V2/V1) which is a ratio of the rate (V1) of a revolution outer ring of spiral wound gasket, and the rate (V2) of a revolution inner ring of spiral wound gasket by forming a damping force value decision means in said damping force control means. Moreover, the velocity ratio (V2/V1) is set as the optimal velocity ratio which was most suitable for the present steering condition by processing of an optimal velocity ratio operation means in this case.

[0011] Therefore, before receiving a travelling direction, it can become possible to generate the damping force of the magnitude which was most suitable for the present operational status (namely, a revolution include angle, the vehicle speed, etc.) of a car to a side revolution inner ring of spiral wound gasket, and the operability and driving stability at the time of revolution can be raised.
[0012]
[Embodiment of the Invention] Next, the gestalt of operation of this invention is explained with a drawing. Drawing 1 is the system configuration Fig. of the steering control device which is one example of this invention, and drawing 2 is the block diagram of the control system of a steering control device. The steering control unit concerning this example functions also as a damping force control unit, and is controlled by the electronic control unit 10 (ECU10 is called hereafter). Hereafter, the concrete configuration of a steering control unit is explained.
[0013] The steering control unit is equipped with the pump 12. The pump 12 is equipped with the motor 14 as the source of power. Inhalation opening 12a of a pump 12 is open for free passage on the reservoir tank 16, and delivery 12b of a pump 12 is open for free passage to the accumulator 20. A pump 12 feeds brake Froude in the reservoir tank 16 from delivery 12b so that predetermined fluid pressure may always accumulate pressure in an accumulator 20.
[0014] The accumulator 20 is open for free passage through the high-pressure path 22 to high-pressure port 24a of a regulator 24, and the regulator switch solenoid 26 (STR26 is called hereafter). The regulator 24 is equipped with low voltage port 24b which is open for free passage on the reservoir tank 16 through the low voltage path 28, and control fluid pressure port 24c which is open for free passage to STR26 through the control fluid pressure path 29. STR26 is the solenoid valve of two locations which make switch-on alternatively either the control fluid pressure path 29 or the high-pressure path 22, in an ordinary state, makes the control fluid pressure path 29 switch-on, and makes the high-pressure path 22 a cut off state.
[0015] While the brake pedal 30 is connected, the master cylinder 32 is being fixed to the regulator 24. The regulator 24 equips the interior with the liquid pressure chamber. A liquid pressure chamber is alternatively opened for free passage by high-pressure port 24a or low voltage port 24b according to the actuation condition of a brake pedal 30 while control fluid pressure port 24c is always open for free passage.
[0016] For a regulator 24, the internal pressure of a liquid pressure chamber is the brake treading strength FP which acts on a brake pedal 30. It is constituted so that it may be adjusted to the fluid pressure which responded. For this reason, in control fluid pressure port 24c of a regulator 24, it is always the brake treading strength FP. The fluid pressure which responded appears (this fluid pressure is called regulator ** PRE). Brake treading strength FP which acts on a brake pedal 30 It is mechanically transmitted to a master cylinder 32 through a regulator 24. Moreover, the force according to regulator ** PRE is transmitted to a master cylinder 32, having corresponded to the fluid pressure of the liquid pressure chamber of a regulator 24 (this force is called the brake assistant force FA). Therefore, if it gets into a brake pedal 30, in a master cylinder 32, it is the brake treading strength FP. Brake assistant force FA Resultant force is transmitted.
[0017] The master cylinder 32 equips the interior with 1st liquid pressure chamber 32a and 2nd liquid pressure chamber 32b. In 1st liquid pressure chamber 32a and 2nd liquid pressure chamber 32b, it is the brake treading strength FP. Brake assistant force FA Master-cylinder-pressure PM/C according to resultant force It generates. Master-cylinder-pressure PM/C generated in 1st liquid pressure chamber 32a And master cylinder pressure PM/C generated in 2nd liquid pressure chamber 32b It is open for free passage to both the proportioning valves 34 (the P bulb 34 is called hereafter).
[0018] On the P bulb 34, the 1st fluid pressure path 36 and the 2nd fluid pressure path 38 are open for free passage. The P bulb 34 is master-cylinder-pressure PM/C. In the field with which a predetermined value is not filled, it is master-cylinder-pressure PM/C to the 1st fluid pressure path 36 and the 2nd fluid pressure path 38. It supplies as it is. Moreover, the P bulb 34 is master-cylinder-pressure PM/C. In the field exceeding a predetermined value, it is master-cylinder-pressure PM/C to the 1st fluid pressure path

36. While supplying as it is, it is master-cylinder-pressure PM/C to the 2nd fluid pressure path 38. The fluid pressure decompressed by the predetermined ratio is supplied.
[0019] In the path which connects 2nd liquid pressure chamber 32b of a master cylinder 32, and the P bulb 34, it is master-cylinder-pressure PM/C. The oil pressure sensor 40 which outputs the embraced electrical signal is arranged. The output signal of an oil pressure sensor 40 is supplied to ECU10. ECU10 is master-cylinder-pressure PM/C produced in the master cylinder 32 based on the output signal of an oil pressure sensor 40. It detects.
[0020] To STR26 mentioned above, the 3rd fluid pressure path 42 is open for free passage. Let the 3rd fluid pressure path 42 be one side and switch-on of the control fluid pressure path 29 or the high-pressure path 22 according to the condition of STR26. In this example, brake fluid pressure is supplied to foil cylinder 44floor line arranged by the right-and-left front wheels floor line and FR and 44FR from the 1st fluid pressure path 36 which is open for free passage on the P bulb 34, or the 3rd fluid pressure path 42 which is open for free passage to STR26. Moreover, brake fluid pressure is supplied to foil cylinder 44RL arranged by the right-and-left rear wheels RL and RR and 44RR from the 2nd fluid pressure path 38 which is open for free passage on the P bulb 34, or the 3rd fluid pressure path 42 which is open for free passage to STR26. Each of this foil cylinder 44floor line, 44FR, 44RL, and 44RR function as a braking means to perform braking actuation independently to each wheels floor line, FR, RL, and RR.
[0021] In the 1st fluid pressure path 36, the 1st assistant solenoid 46 (SA-146 are called hereafter) and the 2nd assistant solenoid 48 (SA-248 are called hereafter) are open for free passage. On the other hand, in the 3rd fluid pressure path 42, the forward right ring maintenance solenoid 50 (SFRH50 is called hereafter), the forward left ring maintenance solenoid 52 (SFLH52 is called hereafter), and the 3rd assistant solenoid 54 (SA-354 are called hereafter) are open for free passage.
[0022] In addition, boost equipment 55 is formed in the location in the middle of the 1st fluid pressure path 36. In the condition that the fluid pressure from the accumulator 20 mentioned later brakes, when the pressure of the fluid pressure supplied declines, this boost equipment 55 is constituted so that the fluid pressure of front wheel cylinder 44floor line and 44FR may be boosted, and it is considered as the configuration which secures high damping force by this. Moreover, 57 is a pressure limiter, to the input negative pressure beyond the emasculation force limitation of a regulator 24, closes a path with a regulator 24 and forbids actuation of boost equipment 55.
[0023] the electromagnetism of two locations where SFRH50 maintains a valve-opening condition in an ordinary state -- it is a closing motion valve. SFRH50 is open for free passage through the fluid pressure path 56 for pressure regulation to SA-248 and the forward right ring reduced pressure solenoid 58 (SFRR58 is called hereafter). Between the 3rd fluid pressure path 42 and the fluid pressure path 56 for pressure regulation, the check valve 60 which permits only the flow of the fluid which goes to the 3rd path 42 side from the fluid pressure path 56 side for pressure regulation is installed.
[0024] SA-248 are the solenoid valve of two locations which make foil cylinder 44FR flow through either the 1st fluid pressure path 36 or the fluid pressure path 56 for pressure regulation alternatively, and make switch-on the 1st fluid pressure path 36 and foil cylinder 44FR in an ordinary state (OFF state). the electromagnetism of two locations where SFRR58, on the other hand, makes the fluid pressure path 56 for pressure regulation, and the reservoir tank 16 switch-on or a cut off state -- it is a closing motion valve. SFRR58 makes the fluid pressure path 56 for pressure regulation, and the reservoir tank 16 a cut off state in an ordinary state (OFF state).
[0025] the electromagnetism of two locations where SFLH52 maintains a valve-opening condition in an ordinary state -- it is a closing motion valve. SFLH52 is open for free passage through the fluid pressure path 62 for pressure regulation to SA-146 and the forward left ring reduced pressure solenoid 64 (SFLR64 is called hereafter). Between the 3rd fluid pressure path 42 and the fluid pressure path 62 for pressure regulation, the check valve 66 which permits only the flow of the fluid which goes to the 3rd path 42 side from the fluid pressure path 62 side for pressure regulation is installed.
[0026] SA-146 are the solenoid valve of two locations which make foil cylinder 44floor line flow through either the 1st fluid pressure path 36 or the fluid pressure path 62 for pressure regulation

alternatively, and make switch-on the 1st fluid pressure path 36 and foil cylinder 44floor line in an ordinary state (OFF state). the electromagnetism of two locations where SFLR64, on the other hand, makes the fluid pressure path 62 for pressure regulation, and the reservoir tank 16 switch-on or a cut off state -- it is a closing motion valve. SFLR64 makes the fluid pressure path 62 for pressure regulation, and the reservoir tank 16 a cut off state in an ordinary state (OFF state).

[0027] The 2nd fluid pressure path 38 is open for free passage to SA-354 mentioned above. To the downstream of SA-354, the right rear ring maintenance solenoid 68 (SRRH68 is called hereafter) prepared corresponding to foil cylinder 44RR of the right rear ring RR and the left rear ring maintenance solenoid 70 (the following, SRLH70) prepared corresponding to foil cylinder 44RL of the left rear ring RL are open for free passage. SA-354 are the solenoid valve of two locations which make SRRH68 and SRLH70 open alternatively either the 2nd fluid pressure path 38 or the 3rd fluid pressure path 42 for free passage, and make the 2nd fluid pressure path 38, and SRRH68 and SRLR70 a free passage condition in an ordinary state (OFF state).

[0028] To the downstream of SRRH68, foil cylinder 44RR and the right rear ring reduced pressure solenoid 74 (SRRR74 is called hereafter) are open for free passage through the fluid pressure path 72 for pressure regulation. the electromagnetism of two locations where SRRR74 makes the fluid pressure path 72 for pressure regulation, and the reservoir tank 16 switch-on or a cut off state -- it is a closing motion valve and the fluid pressure path 72 for pressure regulation and the reservoir tank 16 are made into a cut off state in an ordinary state (OFF state). Moreover, between SA-354 and the fluid pressure path 72 for pressure regulation, the check valve 76 which permits only the flow of the fluid which goes to SA-354 side from the fluid pressure path 72 side for pressure regulation is installed.

[0029] Similarly, to the downstream of SRLH70, foil cylinder 44RL and the left rear ring reduced pressure solenoid 80 (SRLR80 is called hereafter) are open for free passage through the fluid pressure path 78 for pressure regulation. the electromagnetism of two locations where SRLR80 makes the fluid pressure path 78 for pressure regulation, and the reservoir tank 16 switch-on or a cut off state -- it is a closing motion valve and the fluid pressure path 78 for pressure regulation and the reservoir tank 16 are made into a cut off state in an ordinary state (OFF state). Moreover, between SA-354 and the fluid pressure path 78 for pressure regulation, the check valve 82 which permits only the flow of the fluid which goes to SA-354 side from the fluid pressure path 78 side for pressure regulation is installed.

[0030] In the system of this example, near the right-and-left front wheels floor line and FR and the right-and-left rear wheels RL and RR, whenever each wheel carries out predetermined angle-of-rotation rotation, respectively, wheel speed sensor 86floor line which emits a pulse signal, 86FR, 86RL, and 86RR (hereafter, when naming these generically, sign 86** is attached and expressed) are arranged. The output signal of wheel speed sensor 86** is supplied to ECU10. ECU10 detects whenever [rotational-speed / of each wheels floor line, FR, RL, and RR /, i.e., wheel speed of each wheels floor line, FR, RL, and RR] based on the output signal of wheel speed sensor 86**.

[0031] Moreover, the steering sensor 88 which functions as a steering angle detection means to detect the steering direction of a steering wheel, and the speed sensor 90 which detects the rate (SPD) and travelling direction (advance or retreat) of a car which are one of the operational status of a car are connected to ECU10. The steering sensor 88 detects the hand of cut and angle of rotation of a steering shaft, and is constituted by the slit plate which rotates in one with a steering shaft, and the phot interrupter arranged on both sides of this.

[0032] Moreover, a speed sensor 90 detects the rate SPD of a car, and is constituted by the magnet which rotates by rotation of the gear of transmission, and the magnetometric sensor which detects the field of this magnet. In addition, the rate SPD of a car can also be calculated based on above mentioned wheel speed sensor 86**. ECU10 supplies a driving signal suitably to STR26 mentioned above, SA-146, SA-248, SA-354, and SFRH50, SFLH52, SFRR58, SFLR64, SRRH68, SRLH70, SRRR74 and SRLR80 based on the output signal of an oil pressure sensor 40, wheel speed sensor 86**, the steering sensor 88, and a speed sensor 90.

[0033] In addition, drawing 1 shows the steering control unit of the shown ordinary state, and all of STR26 therefore mentioned above, SA-146, SA-248, SA-354, and SFRH50, SFLH52, SFRR58,

SFLR64, SRRH68, SRLH70, SRRR74 and SRLR80 are in the OFF condition. Next, actuation of the steering control unit of this example is explained.
[0034] As described above, the steering control unit concerning this example functions also as a damping force control unit. First, in advance of the actuation as a steering control unit, the actuation as a damping force control unit is explained. brake treading strength FP which acts on a brake pedal 30 when the steering control device (damping force control device) of this example has the stable car condition the embraced damping force is generated -- control is usually performed. Usually, control is realized by making all of STR26, SA-146, SA-248, SA-354, and SFRH50, SFLH52, SFRR58, SFLR64, SRRH68, SRLH70, SRRR74 and SRLR80 into an OFF state, as shown in drawing 1 .
[0035] That is, in the condition which shows in drawing 1 , foil cylinder 44FR and 44floor lines are opened for free passage by the 1st fluid pressure path 36, and foil cylinder 44RR and 44RL(s) are opened for free passage by the 2nd fluid pressure path 38, respectively. In this case, it will be delivered and received between a master cylinder 32, and foil cylinder 44FR, 44floor line, 44RL and 44RR (hereafter, when naming these generically, sign 44** is attached and expressed), it sets for each wheels floor line, FR, RL, and RR, and brake Froude is the brake treading strength FP. The embraced damping force is generated.
[0036] In this example, if possibility of shifting to a lock condition about which wheel is detected, it will be distinguished that the execution condition of anti-lock brake control (ABS control is called henceforth) was satisfied, and ABS control will be started henceforth. ECU10 calculates VwFL, VwFR, VwRL, and VwRR (hereafter, when naming these generically, sign Vw** is attached and expressed) whenever [wheel speed / of each wheel] based on the output signal of speed sensor 86**, and calculates the estimate VSO (VSO is called whenever [presumed car-body-speed] hereafter) of whenever [car-body-speed] by well-known technique based on Vw** whenever [those wheel speed]. And when a car is in a braking condition, slip ratio S of each wheel is calculated according to a degree type, and when S is over the predetermined value, it is judged that the wheel may shift to a lock condition.
[0037]
S=(VSO-SPDVw**) -100-/VS0 ... (1)
If the execution condition of ABS control is satisfied about one of wheels, ECU10 will output a driving signal to SA-146 corresponding to the wheel for which the execution condition of ABS control was satisfied, SA-248, or SA-354. In addition, about a front wheel, it is possible to perform ABS control to right-and-left ring independence, and ABS control is performed [right-and-left ring] about a rear wheel.

[0038] If the execution condition of ABS control will be satisfied about a forward right ring and SA-146 will be in an ON state, foil cylinder 44FR will be intercepted from the 1st fluid pressure path 36, and will be opened for free passage by the fluid pressure path 56 for pressure regulation. Moreover, if the execution condition of ABS control will be satisfied about a forward left ring and SA-248 will be in an ON state, foil cylinder 44floor line will be intercepted from the 1st fluid pressure path 36, and will be opened for free passage by the fluid pressure path 62 for pressure regulation. Furthermore, if the execution condition of ABS control will be satisfied about either a left rear ring and a right rear ring and SA-354 will be in an ON state, the upstream of SRRH68 and SRLH70 will be intercepted from the 2nd fluid pressure path 38, and will be opened for free passage by the 3rd fluid pressure path 42.
[0039] In this case, foil cylinder 44** of a wheel by which ABS control is performed Each maintenance solenoid SFRH50, SFLH52, and SRRH68 or SRLH70 (hereafter, when naming these generically) And it calls maintenance solenoid S**H, they are each reduced pressure solenoid SFRR58, SFLR64, and SRRR74 or SRLR80 (hereafter, when naming these generically). It is open for free passage for calling reduced pressure solenoid S**R, and regulator ** PRE is led to the upstream of all maintenance solenoid S**H through the 3rd fluid pressure path 42 and STR26.
[0040] Foil cylinder pressure PW/C of foil cylinder 44** which corresponds by making maintenance solenoid S**H into a valve-opening condition, and making reduced pressure solenoid S**R into a clausilium condition under the above-mentioned situation It boosts considering regulator ** PRE as a

upper limit. Hereafter, this condition is called ** boost mode. Moreover, foil cylinder pressure PW/C of foil cylinder 44** which corresponds by making maintenance solenoid S**H into a clausilium condition, and making reduced pressure solenoid S**R into a clausilium condition It is held without fluctuating. Hereafter, this condition is called ** hold mode.
[0041] Furthermore, foil cylinder pressure PW/C of foil cylinder 44** which corresponds by making maintenance solenoid S**H into a clausilium condition, and making reduced pressure solenoid S**R into a valve-opening condition It decompresses. Hereafter, this condition is called ** reduced pressure mode. ECU10 realizes ** boost mode, ** hold mode, and ** reduced pressure mode which were suitably mentioned above so that slip ratio S of each wheel at the time of braking may be settled in a suitable value, namely, so that each wheel may not shift to a lock condition. Thus, by performing ABS control, it is prevented that a lock arises for a wheel and, thereby, the driving stability of a car is maintained appropriately.
[0042] In addition, although it has the function to perform VSC and TRC other than the above-mentioned ABS control as control for the system of this example to raise the driving stability of a car, since there is no direct relation to the summary of the invention in this application, the explanation about this function shall be omitted. . Then, the actuation as a steering control unit used as the description of this example is explained.
[0043] Drawing 3 is a flow chart which shows the steering control processing which ECU10 performs, and drawing 4 thru/or drawing 11 are drawings showing the operating state of the steering control unit carried out according to the operational status of a car. In this example, the small turn nature at the time of revolution is raised by boosting foil cylinder 44** alternatively according to the operational status of a car, and generating damping force. Hereafter, concrete actuation is explained.
[0044] The steering control processing shown in drawing 3 is routine processing carried out for every predetermined time. When the steering control processing shown in this drawing starts, ECU10 is step 10 (by a diagram) first. Set and VwFL, VwFR, VwRL, and VwRR are calculated whenever [wheel speed / of each wheel] based on the output signal of speed sensor 86**. a step is called S for short -- **** -- Based on the output signal of the steering sensor 88, the handle piece angle ST from a handle center valve position (henceforth the steering angle ST) is calculated, and SPD is further calculated whenever [car-body-speed] based on the output signal of a speed sensor 90.
[0045] At continuing step 12, it is judged based on the result of an operation of step 10 whether SPD is zero whenever [car-body-speed] (SPD!=0). the condition that do not ask advance and retreat but the car body is advancing in this decision -- or the condition of having stopped is judged. And since it is not necessary to perform steering control processing when negative judgment is carried out at step 12 (i.e., when it is judged that the car body has stopped), it has composition which ends this routine processing.
[0046] On the other hand, when affirmative judgment is carried out at step 12 (i.e., when it is judged that it is in the condition that the car body is advancing), processing progresses to step 14 and it is judged whether the absolute value (|SPD|) of SPD is [whenever / car-body-speed / which was calculated at step 10 / whenever / control authorization car-body-speed] smaller than VH (|SPD|<=VH). Here, the absolute value of SPD is taken whenever [car-body-speed] for advance and retreat of a car body not being involved, but asking for the magnitude of whenever [car-body-speed].
[0047] In this example, since it is the purpose to raise the small turn nature at the time of low-speed transit of vehicle warehousing or column parking, SPD ****s in the configuration in vehicle warehousing or column parking which does not perform [as opposed to / usually / the maximum (this is called VH whenever / control authorization car-body-speed /) of a rate] steering control processing after step 16 when large whenever [car-body-speed]. Therefore, when negative judgment is carried out in step 14, it has composition which ends this routine processing.
[0048] on the other hand, when affirmative judgment is carried out at step 14 (i.e., when the absolute value of SPD is judged [whenever / car-body-speed] to be smaller than VH whenever [control authorization car-body-speed]). processing progresses to step 16 and the current car body is moving forward -- or it is judged whether it is retreating. Decision of this advance and retreat can be judged with the output signal of a speed sensor 90. When it is judged at step 16 that it is advance, it progresses to

step 18 and the steering condition of a current steering is judged. Decision of this steering condition can be performed based on the output signal of the steering sensor 88.
[0049] In step 18, since it is not necessary to perform steering control when a current steering condition is judged to be neutrality, it has composition which ends this routine processing. Moreover, when a current steering condition is judged to be in the condition of the right end in step 18, processing progresses to step 20 and it is judged whether the absolute value (|ST|) of the steering angle ST is larger than the control initiation handle piece angle SH (|ST|>=SH).
[0050] Since it is the purpose to raise the small turn nature when carrying out rotation actuation of the steerings, such as vehicle warehousing or column parking, greatly in this example as described above, it is not necessary to perform steering control in the case (namely, a rectilinear-propagation condition or the condition near this) where the steering angle ST is small. For this reason, to the maximum steering angle (this is called control initiation handle piece angle SH) of the steering at the time of transit, the steering angle ST is usually considering as the configuration which does not perform steering control processing, when small. Therefore, when negative judgment is carried out in step 20, it has composition which ends this routine processing.
[0051] On the other hand, when affirmative judgment is carried out at step 20 (i.e., when the absolute value (|ST|) of the steering angle ST is larger than the control initiation handle piece angle SH), it is in the condition which advanced at a low speed, and is in the condition of operating the steering greatly. Namely, especially when affirmative judgment is carried out at step 20, it is in the condition that the small turn nature of a car is required. Therefore, it progresses to step 22 in this case, and advance right end control is carried out that small turn nature should be improved. In addition, about advance right end control, it considers as the thing of explanation explained in full detail behind for convenience.
[0052] Moreover, when a current steering condition is judged to be in the condition of the left end in step 18, processing progresses to step 24 and it is judged whether the absolute value (|ST|) of the steering angle ST is larger than the control initiation handle piece angle SH like step 20 (|ST|>=SH). As mentioned above, since it is not necessary to perform steering control processing when the steering angle ST is smaller than the control initiation handle piece angle SH, when negative judgment is therefore carried out in step 24, it has composition which ends this routine processing.
[0053] On the other hand, when affirmative judgment is carried out at step 24 (i.e., when the absolute value (|ST|) of the steering angle ST is larger than the control initiation handle piece angle SH), it is in the condition which advanced at a low speed, and is in the condition of operating the steering greatly. Therefore, also when affirmative judgment is carried out at step 24, it is in the condition that the small turn nature of a car is required. Therefore, in this case, processing is advanced to step 22 and advance left end control is carried out that small turn nature should be improved. In addition, about advance left end control, it considers as the thing of explanation explained in full detail behind for convenience.
[0054] On the other hand, when it is judged that the car is retreating in step 16, processing progresses to step 28 and judges the steering condition of a current steering. And in step 28, since it is not necessary to perform steering control when a current steering condition is judged to be neutrality, this routine processing is ended. Moreover, when a current steering condition is judged to be in the condition of the right end in step 28, processing progresses to step 30 and it is judged whether the absolute value (|ST|) of the steering angle ST is larger than the control initiation handle piece angle SH (|ST|>=SH).
[0055] As mentioned above, when the steering angle ST is small (namely, a rectilinear-propagation condition or the condition near this), it is not necessary to perform steering control. Therefore, when negative judgment is carried out in step 30, this routine processing has composition to end. On the other hand, when affirmative judgment is carried out at step 34 (i.e., when the absolute value (|ST|) of the steering angle ST is larger than the control initiation handle piece angle SH), it is in the condition which advanced as mentioned above at a low speed, and is in the condition of operating the steering greatly. Therefore, also when affirmative judgment is carried out at step 24, it is in the condition that the small turn nature of a car is required.
[0056] Therefore, processing is advanced to step 32 in this case, and retreat right end control is carried out that small turn nature should be improved. In addition, about retreat right end control, it considers as

the thing of explanation explained in full detail behind for convenience. Moreover, when a current steering condition is judged to be in the condition of the left end in step 28, processing progresses to step 34 and it is judged whether the absolute value (|ST|) of the steering angle ST is larger than the control initiation handle piece angle SH like step 30 (|ST|>=SH). As mentioned above, since it is not necessary to perform steering control processing when the steering angle ST is smaller than the control initiation handle piece angle SH, when negative judgment is therefore carried out in step 34, it has composition which ends this routine processing.

[0057] On the other hand, when affirmative judgment is carried out at step 34 (i.e., when the absolute value (|ST|) of the steering angle ST is larger than the control initiation handle piece angle SH), it is in the condition which advanced at a low speed, and is in the condition of operating the steering greatly. Therefore, also when affirmative judgment is carried out at step 34, it is in the condition that the small turn nature of a car is required. Therefore, in this case, processing is advanced to step 36 and retreat left end control is carried out that small turn nature should be improved. In addition, about retreat left end control, it considers as the thing of explanation explained in full detail behind for convenience.

[0058] Then, the advance right end control carried out at the above mentioned step 22, the advance left end control carried out at step 26, the retreat right end control carried out at step 32, and the retreat left end control carried out at step 36 are explained. When it is going to raise small turn nature with damping force, before receiving a travelling direction, it is effective in a side revolution inner ring of spiral wound gasket to generate damping force. If a side revolution inner ring of spiral wound gasket is made to generate damping force before receiving a travelling direction, the TR of the outermost part of the car body at the time of revolution can be made small, and, therefore, small turn nature can be raised. In the advance right end control carried out at the above mentioned step 22, the advance left end control carried out at step 26, the retreat right end control carried out at step 32, and the retreat left end control carried out at step 36, control processing is performed based on this principle. [Advance right end control] Advance right end control is explained first. Drawing 4 and drawing 5 are drawings for explaining the advance right end control carried out at step 22. In order to raise small turn nature when a car 92 performs the advance right end as shown in drawing 5 , before receiving a travelling direction, it is desirable to make the forward right ring FR which is a side revolution inner ring of spiral wound gasket generate damping force.

[0059] So, in the advance right end control carried out at step 22, it considers as the configuration to which brake Froude is supplied to foil cylinder 44FR of the forward right ring FR. ECU10 makes STR26 and SA-248 an ON state to the ordinary state specifically shown in drawing 1 as shown in drawing 4 . Thereby, high-pressure brake Froude who was accumulating pressure to the accumulator 20 is supplied to foil cylinder 44FR through the high-pressure path 22, STR26 and SFRH50, the fluid pressure path 56 for pressure regulation, and SA-248, and, therefore, damping force generates him to the forward right ring FR. Thereby, the small turn nature at the time of the advance right end can be raised.

[0060] Moreover, although damping force occurs to the forward right ring FR by the above-mentioned processing, when superfluous damping force occurs, the stability of a car falls on the contrary. Therefore, when superfluous damping force occurs, the pressure in the foil cylinder FR is decompressed by making SFRH50 and SFRR58 into an ON state suitably. And when the pressure in foil cylinder 44FR turns into the optimal pressure which can realize improvement in small turn nature, let SFRR58 be an OFF state again. Thereby, foil cylinder 44FR will hold the optimal pressure, and can maintain the good condition of small turn nature.

[0061] Here, the technique of determining the optimal pressure is explained. In this example, it considers as the configuration which determines the damping force value which each wheel is made to generate based on the velocity ratio (V2/V1) which is a ratio of the rate (V1) of a revolution outer ring of spiral wound gasket, and the rate (V2) of a revolution inner ring of spiral wound gasket. If the advance right end control carried out at the aforementioned step 22 is mentioned as an example and explained now, ECU10 will determine the damping force which the forward right ring FR is made to generate based on a velocity ratio (VwFR/VwFL) with VwFR whenever [wheel speed / of the forward right ring FR which are VwFL and a revolution inner ring of spiral wound gasket whenever / wheel

speed / of the forward left ring floor line which is a revolution outer ring of spiral wound gasket].
[0062] Moreover, ECU10 calculates the optimal velocity ratio for which it was most suitable in the current steering condition based on the steering angle ST searched for by SPD and the steering sensor 88 whenever [car-body-speed / which is detected by the speed sensor 90] (this processing is equivalent to processing of a velocity ratio operation means). ECU10 stores the 3 yuan map in which the relation of SPD is shown whenever [velocity ratio / for which ROM installed inside was beforehand asked by experiment etc. /, steering angle ST, and car-body-speed]. And it considers as the configuration which calculates the optimal velocity ratio by referring to the map of this 3 yuan.
[0063] Drawing 12 shows an example of a map of this 3 yuan. The example which calculates the optimal velocity ratio using this drawing is explained. Now, suppose that the current steering angle ST was theta 1, and SPD was SPD2 whenever [car-body-speed]. Then, it is determined from the 3 yuan map of drawing 12 that the optimal velocity ratio is alpha. That is, the optimal small turn nature can be obtained by controlling to be set to =(VwFR/VwFL) alpha.
[0064] Moreover, as described above, VwFR is always detected [whenever / wheel speed / of the forward left ring floor line] by wheel speed sensor 86floor line and 86FR whenever [wheel speed / of VwFL and the forward right ring FR]. Therefore, pressure control of foil cylinder 44FR is performed by always calculating the velocity ratio (VwFR/VwFL) after making the forward right ring FR generate damping force as mentioned above, and carrying out drive control of SFRH50 and SFRR58 so that this velocity ratio (VwFR/VwFL) may turn into the optimal velocity ratio alpha.
[0065] Driving stability can be raised, while becoming possible to generate the damping force of the magnitude which was most suitable for the present operational status (namely, whenever [revolution include-angle ST and car-body-speed] SPD) of a car and being able to obtain the optimal small turn nature to a side revolution inner ring of spiral wound gasket by this at the time of revolution, before receiving a travelling direction. In addition, same control processing is performed also in the advance left end control explained below, retreat right end control, and retreat left end control, and improvement is aimed at for the improvement in small turn nature, and driving stability.
[Advance left end control] Next, advance left end control is explained. Drawing 6 and drawing 7 are drawings for explaining the advance left end control carried out at step 26. In order to raise small turn nature when a car 92 performs the advance left end as shown in drawing 7 , before receiving a travelling direction, it is desirable to make the forward left ring floor line which is a side revolution inner ring of spiral wound gasket generate damping force.
[0066] So, in the advance left end control carried out at step 26, it considers as the configuration to which brake Froude is supplied to foil cylinder 44floor line of the forward left ring floor line. ECU10 makes STR26 and SA-146 an ON state to the ordinary state specifically shown in drawing 1 as shown in drawing 6 . Thereby, high-pressure brake Froude who was accumulating pressure to the accumulator 20 is supplied to foil cylinder 44floor line through the high-pressure path 22, STR26 and SFLH52, the fluid pressure path 62 for pressure regulation, and SA-146, and, therefore, damping force generates him to the forward left ring floor line. Thereby, the small turn nature at the time of the advance left end can be raised.
[0067] Moreover, although damping force occurs to the forward left ring floor line by the above-mentioned processing, when superfluous damping force occurs, the stability of a car falls on the contrary. Therefore, when superfluous damping force occurs, the pressure in the foil cylinder floor line is decompressed by making SFLH52 and SFLR64 into an ON state suitably. And when the pressure in foil cylinder 44floor line turns into the optimal pressure which can realize improvement in small turn nature, let SFLR64 be an OFF state again. Thereby, foil cylinder 44floor line will hold the optimal pressure, and can maintain the good condition of small turn nature.
[Retreat right end control] Drawing 8 and drawing 9 are drawings for explaining the retreat right end control carried out at step 32. In order to raise small turn nature when a car 92 performs the retreat right end as shown in drawing 9 R> 9, before receiving a travelling direction, it is desirable to make the right rear ring RR which is a side revolution inner ring of spiral wound gasket generate damping force.
[0068] So, in the retreat right end control carried out at step 32, it considers as the configuration to

which brake Froude is supplied to foil cylinder 44RR of the right rear ring RR. ECU10 makes an ON state STR26, SA-354, and SRLR70 to the ordinary state specifically shown in drawing 1 as shown in drawing 8 . Thereby, high-pressure brake Froude who was accumulating pressure to the accumulator 20 is supplied to foil cylinder 44RR through the high-pressure path 22, STR26, SA-354, SRRH68, and the fluid pressure path 72 for pressure regulation, and, therefore, damping force generates him to the right rear ring RR. Thereby, the small turn nature at the time of the retreat right end can be raised.

[0069] Moreover, although damping force occurs to the right rear ring RR by the above-mentioned processing, when superfluous damping force occurs, the stability of a car falls on the contrary. Therefore, when superfluous damping force occurs, the pressure in foil cylinder 44RR is decompressed by making SRRH68 and SRRR74 into an ON state suitably. And when the pressure in foil cylinder 44RR turns into optimal pressure (henceforth the optimal pressure) which can realize improvement in small turn nature, let SRRR74 be an OFF state again. Thereby, foil cylinder 44RR will hold the optimal pressure, and can maintain the good condition of small turn nature.

[Retreat left end control] Next, retreat left end control is explained. Drawing 10 and drawing 11 are drawings for explaining the retreat left end control carried out at step 36. In order to raise small turn nature when a car 92 performs the retreat left end as shown in drawing 11 , before receiving a travelling direction, it is desirable to make the left rear ring RL which is a side revolution inner ring of spiral wound gasket generate damping force.

[0070] So, in the retreat left end control carried out at step 36, it considers as the configuration to which brake Froude is supplied to foil cylinder 44RL of the left rear ring RL. ECU10 makes an ON state SRT26, SA-354, and SRRH68 to the ordinary state specifically shown in drawing 1 as shown in drawing 10 . Thereby, high-pressure brake Froude who was accumulating pressure to the accumulator 20 is supplied to foil cylinder 44RL through the high-pressure path 22, STR26, SA-354, SRLH70, and the fluid pressure path 78 for pressure regulation, and, therefore, damping force generates him to the left rear ring RL. Thereby, the small turn nature at the time of the retreat left end can be raised.

[0071] Moreover, although damping force occurs to the left rear ring RL by the above-mentioned processing, when superfluous damping force occurs, the stability of a car falls on the contrary. Therefore, when superfluous damping force occurs, the pressure in the foil cylinder RL is decompressed by making SRLH70 and SRLR80 into an ON state suitably. And when the pressure in foil cylinder 44RL turns into the optimal pressure which can realize improvement in small turn nature, let SRLR80 be an OFF state again. Thereby, foil cylinder 44RL will hold the optimal pressure, and can maintain the good condition of small turn nature.

[0072] In addition, as described above, the system of the braking control unit corresponding to ABS control generally used conventionally is used for the steering control unit concerning this example as it is, and it is only the control action which ECU10 performs, and has realized optimal small turn nature. Therefore, in order to realize this example, especially, a new configuration cannot be needed and cost PAHOMANSU can be raised.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the steering control unit which attained easy-ization of steering by starting a steering control unit, especially impressing damping force alternatively to each wheel.
[0002]
[Description of the Prior Art] In the case of a common four-flower car, the turn of a car uses two front wheels as a steering wheel, and is performed by steering these two flowers. However, with the configuration (2WS) which only **** and steers two front wheels, a minimum turning radius cannot be made small enough, but, therefore, it is hard to perform steering at the time of transit of a narrow alley, or vehicle warehousing to a narrow parking lot. For this reason, the various equipments which make the radius of gyration of a car small conventionally are developed.
[0003] As equipment which makes small the radius of gyration at the time of this steering, and raises small turn nature, 4WS (Four Wheel Steering System) is known. In addition to two front wheels, this 4WS is taken as the configuration which performs **** also about two rear wheels. Therefore, when two front wheels and two rear wheels were steered to the opposite phase in 4WS and a front wheel is steered on a piece square equivalent to the case of 2WS, if a rear wheel is steered by the opposite phase, a center line of rotation can approach the body, and therefore a minimum turning radius and its inner outer-ring-of-spiral-wound-gasket difference can decrease, and it can raise small turn nature. Thereby, the steering nature at the time of transit of a narrow alley or vehicle warehousing to a narrow parking lot can be raised.
[0004]
[Problem(s) to be Solved by the Invention] However, since 4WS was the configuration of ****(ing) all of four flowers, it had the trouble that the control for an actuator being needed in order to **** each wheel, and ****(ing) each wheel proper was difficult. Moreover, in order to **** a rear wheel, the space section for making **** possible also in the rear wheel arrangement location of a car body needed to be formed, and in order to prepare this space section, there was also a trouble that the capacity of a trunk room decreased.
[0005] This invention is made in view of the above-mentioned point, and it aims at offering the steering control unit which can aim at improvement in small turn nature with an easy configuration by braking to a wheel according to the steering direction alternatively.
[0006]
[Means for Solving the Problem] Thing ****** characterized by providing the means expressed below in this invention in order to solve the above-mentioned technical problem. In the steering control unit concerning invention according to claim 1 A steering angle detection means to detect the steering direction of a steering wheel, and the braking means constituted so that braking actuation could be performed independently to each wheel, An operational status detection means to detect the operational status of a car, and the car travelling direction detected by said operational status detection means, Based

on the steering direction detected by said steering angle detection means, before receiving a travelling direction, it is characterized by establishing the damping force control means which makes a side revolution inner ring of spiral wound gasket generate damping force.
[0007] Moreover, in invention according to claim 2, it sets to said steering control unit according to claim 1. A damping force value decision means to determine the damping force value which said damping force control means is made to generate for each wheel based on the velocity ratio (V2/V1) which is a ratio of the rate (V1) of a revolution outer ring of spiral wound gasket and the rate (V2) of a revolution inner ring of spiral wound gasket which are found by said operational status detection means, It is characterized by establishing an optimal velocity ratio operation means to ask for the optimal velocity ratio for which it was most suitable in the current steering condition, based on whenever [car-body-speed / which is detected by said operational status detection means], and said steering angle.
[0008] The above-mentioned means acts as follows. According to invention according to claim 1, a steering angle detection means detects the steering direction of a steering wheel, and transmits this information to a damping force control means. Moreover, an operational status detection means detects the operational status of a car, and transmits the travelling direction **** signal of the car which is one of the operational status to a damping force control means. Moreover, the braking means is considered as the configuration so that braking actuation can be performed independently to each wheel.
[0009] And a damping force control means makes a side revolution inner ring of spiral wound gasket generate damping force based on the car travelling direction detected by said operational status detection means, and the steering direction detected by said steering angle detection means, before receiving a travelling direction. for example, when a travelling direction is the front and the steering direction is the right, a damping force control means makes a before side right wheel generate damping force -- it obtains and a braking means is controlled. Thus, before receiving a travelling direction, by making a side revolution inner ring of spiral wound gasket generate damping force, the TR of the outermost part of the car body at the time of revolution can be made small, and, therefore, small turn nature can be raised.
[0010] Moreover, according to invention according to claim 2, the damping force value which each wheel is made to generate is determined based on the velocity ratio (V2/V1) which is a ratio of the rate (V1) of a revolution outer ring of spiral wound gasket, and the rate (V2) of a revolution inner ring of spiral wound gasket by forming a damping force value decision means in said damping force control means. Moreover, the velocity ratio (V2/V1) is set as the optimal velocity ratio which was most suitable for the present steering condition by processing of an optimal velocity ratio operation means in this case.

[0011] Therefore, before receiving a travelling direction, it can become possible to generate the damping force of the magnitude which was most suitable for the present operational status (namely, a revolution include angle, the vehicle speed, etc.) of a car to a side revolution inner ring of spiral wound gasket, and the operability and driving stability at the time of revolution can be raised.
[0012]
[Embodiment of the Invention] Next, the gestalt of operation of this invention is explained with a drawing. Drawing 1 is the system configuration Fig. of the steering control device which is one example of this invention, and drawing 2 is the block diagram of the control system of a steering control device. The steering control unit concerning this example functions also as a damping force control unit, and is controlled by the electronic control unit 10 (ECU10 is called hereafter). Hereafter, the concrete configuration of a steering control unit is explained.
[0013] The steering control unit is equipped with the pump 12. The pump 12 is equipped with the motor 14 as the source of power. Inhalation opening 12a of a pump 12 is open for free passage on the reservoir tank 16, and delivery 12b of a pump 12 is open for free passage to the accumulator 20. A pump 12 feeds brake Froude in the reservoir tank 16 from delivery 12b so that predetermined fluid pressure may always accumulate pressure in an accumulator 20.
[0014] The accumulator 20 is open for free passage through the high-pressure path 22 to high-pressure port 24a of a regulator 24, and the regulator switch solenoid 26 (STR26 is called hereafter). The

regulator 24 is equipped with low voltage port 24b which is open for free passage on the reservoir tank 16 through the low voltage path 28, and control fluid pressure port 24c which is open for free passage to STR26 through the control fluid pressure path 29. STR26 is the solenoid valve of two locations which make switch-on alternatively either the control fluid pressure path 29 or the high-pressure path 22, in an ordinary state, makes the control fluid pressure path 29 switch-on, and makes the high-pressure path 22 a cut off state.

[0015] While the brake pedal 30 is connected, the master cylinder 32 is being fixed to the regulator 24. The regulator 24 equips the interior with the liquid pressure chamber. A liquid pressure chamber is alternatively opened for free passage by high-pressure port 24a or low voltage port 24b according to the actuation condition of a brake pedal 30 while control fluid pressure port 24c is always open for free passage.

[0016] For a regulator 24, the internal pressure of a liquid pressure chamber is the brake treading strength FP which acts on a brake pedal 30. It is constituted so that it may be adjusted to the fluid pressure which responded. For this reason, in control fluid pressure port 24c of a regulator 24, it is always the brake treading strength FP. The fluid pressure which responded appears (this fluid pressure is called regulator ** PRE). Brake treading strength FP which acts on a brake pedal 30 It is mechanically transmitted to a master cylinder 32 through a regulator 24. Moreover, the force according to regulator ** PRE is transmitted to a master cylinder 32, having corresponded to the fluid pressure of the liquid pressure chamber of a regulator 24 (this force is called the brake assistant force FA). Therefore, if it gets into a brake pedal 30, in a master cylinder 32, it is the brake treading strength FP. Brake assistant force FA Resultant force is transmitted.

[0017] The master cylinder 32 equips the interior with 1st liquid pressure chamber 32a and 2nd liquid pressure chamber 32b. In 1st liquid pressure chamber 32a and 2nd liquid pressure chamber 32b, it is the brake treading strength FP. Brake assistant force FA Master cylinder pressure PM/C according to resultant force It generates. Master-cylinder-pressure PM/C generated in 1st liquid pressure chamber 32a And master cylinder pressure PM/C generated in 2nd liquid pressure chamber 32b It is open for free passage to both the proportioning valves 34 (the P bulb 34 is called hereafter).

[0018] On the P bulb 34, the 1st fluid pressure path 36 and the 2nd fluid pressure path 38 are open for free passage. The P bulb 34 is master-cylinder-pressure PM/C. In the field with which a predetermined value is not filled, it is master-cylinder-pressure PM/C to the 1st fluid pressure path 36 and the 2nd fluid pressure path 38. It supplies as it is. Moreover, the P bulb 34 is master-cylinder-pressure PM/C. In the field exceeding a predetermined value, it is master-cylinder-pressure PM/C to the 1st fluid pressure path 36. While supplying as it is, it is master-cylinder-pressure PM/C to the 2nd fluid pressure path 38. The fluid pressure decompressed by the predetermined ratio is supplied.

[0019] In the path which connects 2nd liquid pressure chamber 32b of a master cylinder 32, and the P bulb 34, it is master-cylinder-pressure PM/C. The oil pressure sensor 40 which outputs the embraced electrical signal is arranged. The output signal of an oil pressure sensor 40 is supplied to ECU10. ECU10 is master-cylinder-pressure PM/C produced in the master cylinder 32 based on the output signal of an oil pressure sensor 40. It detects.

[0020] To STR26 mentioned above, the 3rd fluid pressure path 42 is open for free passage.

* NOTICES *

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the whole steering control unit block diagram which is one example of this invention.
[Drawing 2] It is the block diagram of the control system of the steering control device which is one example of this invention.
[Drawing 3] It is the flow chart which shows the braking control processing carried out at the time of revolution.
[Drawing 4] It is drawing for explaining actuation in case a travelling direction is the front and the steering direction is the right (advance right end).
[Drawing 5] It is drawing for explaining a car condition in case a travelling direction is the front and the steering direction is the right (advance right end).
[Drawing 6] It is drawing for explaining actuation in case a travelling direction is the front and the steering direction is the left (advance left end).
[Drawing 7] It is drawing for explaining a car condition in case a travelling direction is the front and the steering direction is the left (advance left end).
[Drawing 8] It is drawing for explaining actuation in case a travelling direction is back and the steering direction is the right (retreat right end).
[Drawing 9] It is drawing for explaining a car condition in case a travelling direction is back and the steering direction is the right (retreat right end).
[Drawing 10] It is drawing for explaining actuation in case a travelling direction is back and the steering direction is the left.
[Drawing 11] It is drawing for explaining a car condition in case a travelling direction is back and the steering direction is the left.
[Drawing 12] It is drawing showing the map used by the braking control processing carried out at the time of revolution.
[Description of Notations]
10 Electronic Control Unit
26 Regulator Switch Solenoid (STR)
30 Brake Pedal
32 Master Cylinder
40 Oil Pressure Sensor
46 1st Assistant Solenoid (SA-1)
48 2nd Assistant Solenoid (SA-2)
50 Forward Right Ring Maintenance Solenoid (SFRH)
52 Forward Left Ring Maintenance Solenoid (SFLH)
54 3rd Assistant Solenoid (SA-3)
58 Forward Right Ring Reduced Pressure Solenoid (SFRR)
64 Forward Left Ring Maintenance Solenoid (SFLR)
68 Right Rear Ring Maintenance Solenoid (SRRH)

70 Left Rear Ring Maintenance Solenoid (SRLH)
74 Right Rear Ring Reduced Pressure Solenoid (SRRR)
80 Left Rear Ring Maintenance Solenoid (SRLR)
86floor lines, 86FR, 86RL, 86RR Wheel speed sensor
88 Steering Sensor
90 Speed Sensor

[Translation done.]